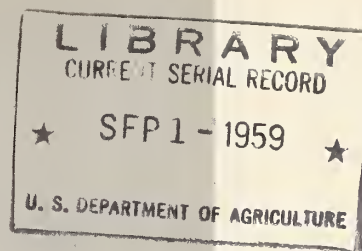


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Apparatus for the Causticaire Method of Measuring

COTTON-FIBER MATURITY

and Fineness



U. S. DEPARTMENT OF AGRICULTURE
Agricultural Marketing Service
Marketing Research Division
Washington, D. C.

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PREFACE

The machines described in this report were designed to meet the need of the cotton industry for a practical means of automatically testing a large volume of cotton samples for maturity and fineness. This study is part of a broad program of continuing research aimed at reducing the cost of marketing farm products.

The machines were built to U. S. Department of Agriculture specifications by Custom Scientific Instruments, Inc., Kearney, N. J., and United States Testing Co., Inc., Hoboken, N. J.

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SUMMARY

A new apparatus, developed by the U. S. Department of Agriculture, permits automatic processing of large numbers of cotton samples for the Causticaire test of cotton-fiber maturity and fineness.

The Causticaire test is a relatively simple method for obtaining measurements of quality factors contributing to the processing performance and product quality of cotton. However, the customary manual treatment of test samples with caustic soda is hazardous to personnel, and it is not economical when processing a large volume of samples.

The new apparatus--the automatic Causticaire machine and dryer--meets the essential requirements for a practical system of treating and drying the samples. It includes a machine for treating the samples with caustic soda solution followed by water rinsing and damp-drying, and a mechanical dryer for reducing the moisture content of the processed samples.

Compared with manual methods of processing test samples, the automatic Causticaire machine and dryer provides the following advantages:

1. Reduction of time required for treating, rinsing, and damp-drying a large volume of samples.
2. Elimination of the services of a technician during treating, rinsing, and damp-drying of samples.
3. Reduction of the risk of injury to the technician from contact with the caustic soda solution used in the process.
4. Reduction of time required to lower the moisture content of the caustic-free damp-dried test samples.

The Causticaire machine is an automatic domestic washing machine redesigned for use with a caustic soda solution. It is adapted to treat a batch of 60 test samples in 49 minutes.

An electric domestic clothes dryer completes the sample processing apparatus. The temperature control system of the clothes dryer is modified to attain a higher operating temperature for rapid drying of the damp-dried test samples. Ordinarily, 60 damp-dried Causticaire samples can be sufficiently dried and cooled, for laboratory reconditioning of the cotton, in 1-1/2 hours of dryer operation with a thermostatically controlled temperature of 220°F.

The Causticaire scale used in testing samples has been modified to permit Causticaire readings for cottons of various botanical types with fineness values by the array method of 1.8 to 10.8 micrograms per inch. The established procedure for testing cotton samples by the Causticaire method remains unchanged when processing the test samples with the Causticaire machine and dryer.

APPARATUS FOR THE CAUSTICAIRE METHOD OF MEASURING COTTON-FIBER MATURITY AND FINENESS

By George E. Gaus, cotton technologist, and
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INTRODUCTION

The Causticaire method of evaluating cotton-fiber maturity and fineness through the application of Micronaire ¹/₁ instrument readings for raw cotton and for the same cotton treated with sodium hydroxide is a relatively simple procedure. Values of fiber maturity and fineness derived by this method have proved to be as effective as the standard methods of obtaining these properties for estimating their importance to processing performance and quality of manufactured cotton textile products.

Although the Causticaire method takes less time than the standard tests for determining cotton fineness and maturity, the present Causticaire sample processing technique--involving manual treatment of the cotton samples with sodium hydroxide solution, hand-rinsing, and then drying these samples in a laboratory oven--is too slow for processing a large number of samples.

To provide a rapid, satisfactory method of processing samples of cotton for evaluation by the Causticaire method, mechanical apparatus has been devised by the U. S. Department of Agriculture to treat, rinse, and dry the samples. The apparatus comprises two pieces of equipment: The Causticaire machine for automatically treating a batch of test samples with sodium hydroxide solution, rinsing, and damp-drying the samples, and a large-capacity electric dryer for drying these samples sufficiently for later reconditioning of the cotton.

Mechanical batch-processing of test samples has several advantages over manual methods. Samples can be treated, rinsed, and damp-dried more quickly in the Causticaire machine. They do not need to be manipulated by a technician during processing, and the risk of an operator coming into contact with the caustic soda solution is reduced. Moisture content of the caustic-free damp-dried samples can be lowered quickly in the automatic dryer.

¹/₁ Sheffield Corporation. Operating Instructions for the Sheffield Micronaire. Catalog No. 56 M 01-116 with supplements. 16 pp., illus. Dayton, Ohio. Jan. 1, 1956.

Review of the Causticaire Test: Method and Technique

The Causticaire method for evaluation of fineness and maturity of cotton fibers by the application of the air-permeability principle was described by Burley and Bartmess. 2/ The method uses a commercially available instrument known as the Micronaire (see footnote 1) with which air-flow readings are made on fluffed, blended samples of raw cotton, and again on the same cotton after treatment with a swelling agent. Further research by Webb and Burley 3/ led to the development of the "Causticaire scale" for use with the Micronaire instrument for determining both fiber fineness and maturity of cottons having a fiber fineness (weight per inch) of less than 8.0 micrograms.

Causticaire Scale

Subsequent to the findings reported by Webb and Burley (see footnote 3), further developmental work was carried on to establish a Causticaire scale accommodating cottons up to 10.8 micrograms per inch. In figure 1, the calculated Causticaire fineness values are compared with fineness values derived from the array weight per inch for 160 cottons of several different botanical species, having array weights of 1.8 to 10.8 micrograms per inch. The Causticaire scale which has been developed from the data obtained from these 160 samples has a range of 27 to 114 index points. The calibration points on this scale are the same as on the previous scale. The formulas for calculating Causticaire fineness and maturity index from the Causticaire scale readings are the same for this scale as those used for the previous scale.

A reduced reproduction of the Causticaire scale is shown in figure 2. This scale is now available for current models of the Micronaire instrument.

Testing by the Causticaire Method

An established test procedure for evaluating fineness and maturity of samples of raw cotton under controlled conditions of temperature and humidity (temperature $70^{\circ}\text{F.} \pm 2^{\circ}$ and relative humidity $65\% \pm 2\%$) uses sodium hydroxide as a swelling agent for the cotton and the Micronaire as an indicating instrument. The procedure is given below:

1. Condition and blend a 7- to 10-gram sample of raw cotton on a laboratory-type mechanical fiber blender, such as the one developed and described by Gaus and Larrison. 4/

2/ Burley, S. T., Jr., and Bartmess, E. S. The Causticaire Method for Determining Cotton-Fiber Maturity and Fineness. U. S. Dept. Agr., Prod. & Mktg. Admin. 20 pp., illus. Aug. 1952.

3/ Webb, R. W., and Burley, S. T., Jr. The Causticaire Method for Determining Cotton-Fiber Maturity and Fineness: Improvement and Evaluation. U. S. Dept. Agr., Agr. Mktg. Serv. 62 pp., illus. Dec. 1953.

4/ Gaus, G. E., and Larrison, J. E. A Mechanical Cotton Fiber Blender for Use in Fiber Testing Laboratories. U. S. Dept. Agr., Prod. & Mktg. Admin. 24 pp., illus. Aug. 1951.

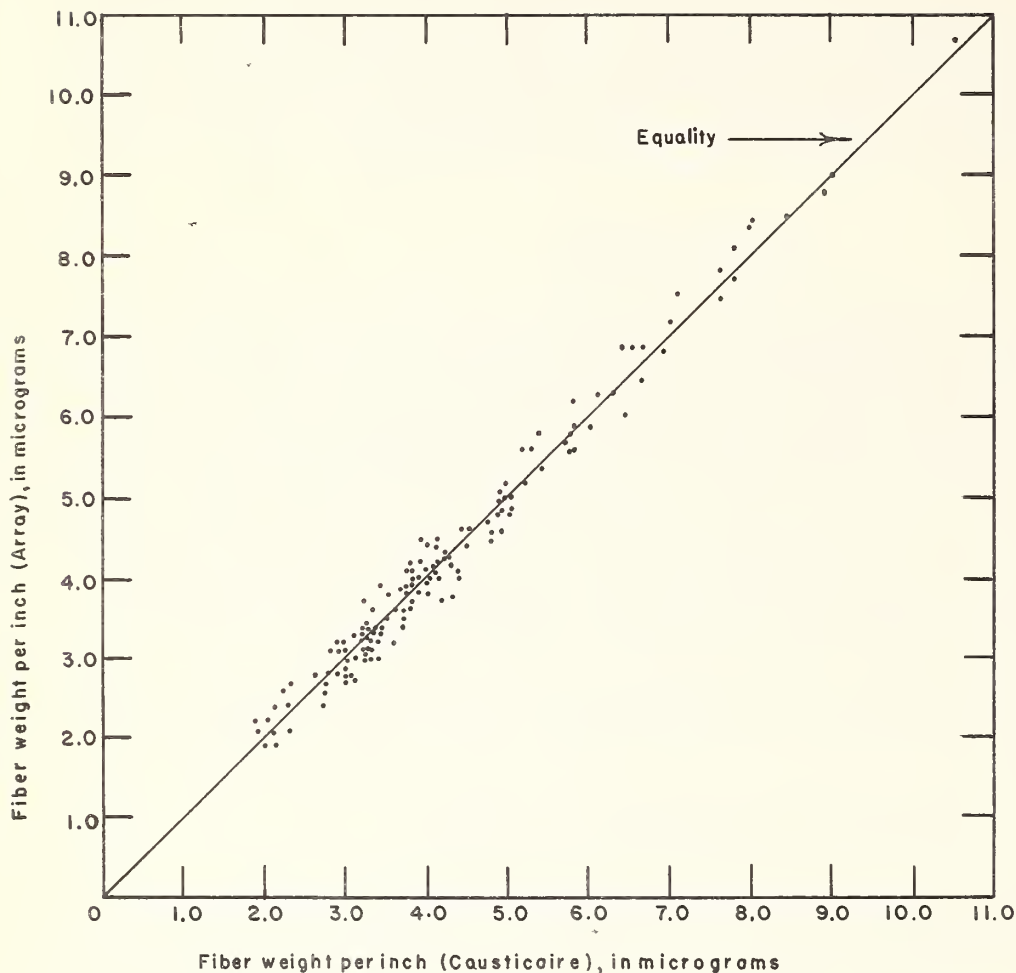


Figure 1

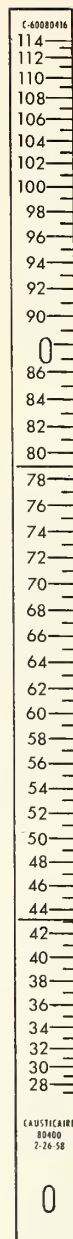


Figure 2

Figure 1.--Relationship between paired values of fiber fineness (weight per inch) for 160 selected cottons, as determined by the Causticaire and array methods.

Figure 2.--Revised Causticaire scale for evaluating cotton-fiber fineness and maturity by use of the Micronaire instrument.

2. After calibrating the Micronaire instrument, weigh two 50-grain specimens of the blended sample and make the usual Micronaire test readings on the two 50-grain specimens (one reading on each specimen) using the Causticaire scale designed for the Micronaire.
3. Treat the two 50-grain specimens combined with the residue of the blended sample in a solution of sodium hydroxide (40° Twaddell scale, or 18 to 20% solution) to which a wetting agent (1 to 1-1/2% by volume) has been added. Be sure the sample is completely saturated.
4. Wring excess caustic soda solution from the treated sample.
5. Wash sample thoroughly in tepid water to remove all traces of caustic solution. Litmus paper may be used to test the condition of the last rinse water.
6. Wring excess moisture from sample.
7. Dry sample to a relatively low moisture content.
8. Recondition the sample and blend on mechanical fiber blender to fluff the cotton.
9. Weigh two 50-grain specimens of the reblended sample and make standard Micronaire tests using the Causticaire scale.
10. Calculate maturity index and fiber weight per inch by formula given by Webb and Burley, using Causticaire scale readings obtained.

Preparation of the Sodium Hydroxide Solution

Investigations of the effect of varying the concentration of solution used in processing the test samples indicate aqueous solutions of sodium hydroxide prepared at room temperatures within a range of density of 36° to 50° on the Twaddell scale produce equally reliable test results (see footnote 3). The concentrations of sodium hydroxide solution used with the Causticaire method, expressed in terms of hydrometer readings, are given in the following tabulation:

Aqueous Sodium Hydroxide Solutions

<u>Degrees Twaddell</u>	<u>Density (Specific gravity)</u>	<u>Degrees Baume'</u>	<u>Percent NaOH</u>	<u>Pounds per gallon</u>
36	1.18	22.12		
39	1.1972	23.9	18	1.798
40	1.20	24.17		
44	1.2191	26.1	20	2.035
50	1.25	29.00		

The required weight of dry sodium hydroxide can be dissolved in water in preparing the caustic soda solution for treating a small number of samples manually.

When a larger volume of caustic soda solution (about 12 gallons) is required for batch-processing samples automatically with the Causticaire machine described herein, the solution can be prepared more economically by dilution of a concentrated solution of sodium hydroxide with water. Saturated aqueous sodium hydroxide solution (about 50% concentration) is commercially available in 13-gallon carboys. Dilution of the 50 percent sodium hydroxide solution with a sufficient volume of water to obtain an 18 to 20 percent solution is relatively simple.

The term, "18 to 20% sodium hydroxide solution" used in this report refers to a concentration approximate to that indicated as 40° on the Twaddell hydrometer scale. In the tabulation shown of concentrations of aqueous sodium hydroxide solutions, it will be observed that the densities (specific gravity) of 18 to 20 percent solutions cover a range of 39° to 44° on the Twaddell scale.

To assure rapid and complete saturation of the sample during immersion, 1 to 1-1/2 percent by volume of a wetting agent is added to the sodium hydroxide solution. The wetting agent is a commercial liquid preparation used in mercerization by the cotton textile industry.

Preparation of Samples for Processing with Sodium Hydroxide Solution

The test samples, which have been previously blended and read on the Micronaire, are enclosed individually in fabric bags for treatment with sodium hydroxide solution. The open end of each bag is drawn together and tied with thread or cord. The free ends of the tie should be cut off short to avoid fraying and consequent accumulation of loose fibers in the sodium hydroxide solution during processing with the Causticaire machine. Each bag bears an identifying mark. Laundry marking ink is satisfactory for identifying the bags.

The bags for the cotton samples are made of Orlon or other woven material which is unaffected by repeated immersion in caustic soda solution, by the stress of mechanical agitation during immersion, and by repeated exposure to drying heat. The fabric is sewn together to form a bag measuring approximately 4 by 6 inches. Different weaves, or constructions, of fabric are used in making sample bags. When the sample is to be treated with caustic solution manually, a woven marquisette is satisfactory for the bags. The mesh fabric permits rapid soaking of the cotton sample with the solution. When the samples are treated with caustic soda solution while being mechanically agitated in the automatic Causticaire machine, a light-weight, plain-weave fabric is used for the sample bags to retard the passage of cotton fibers through the bags into the solution. Escaped fibers in the solution clog the filter element and tend also to block action of the control valves during operation of the Causticaire machine.

Technique of Processing Samples

The Causticaire test method involves five steps in processing raw cotton samples which can be done automatically with the Causticaire machine and the dryer.

These steps are conditions 3, 4, 5, 6, and 7 of the test procedure--Testing by the Causticaire Method--described on page 7.

THE AUTOMATIC CAUSTICAIRE MACHINE AND DRYER

General Information

The apparatus used in batch-processing test samples consists of two separate mechanical units, (1) the Causticaire machine, and (2) the dryer.

The Causticaire machine is similar in principle to an automatic domestic washing machine. The machine is provided with a storage tank for saving the used caustic soda solution for reuse.

A modified domestic laundry dryer, for rapidly drying damp-dried, bagged cotton samples, complements the Causticaire machine for processing test samples.

THE CAUSTICAIRE MACHINE

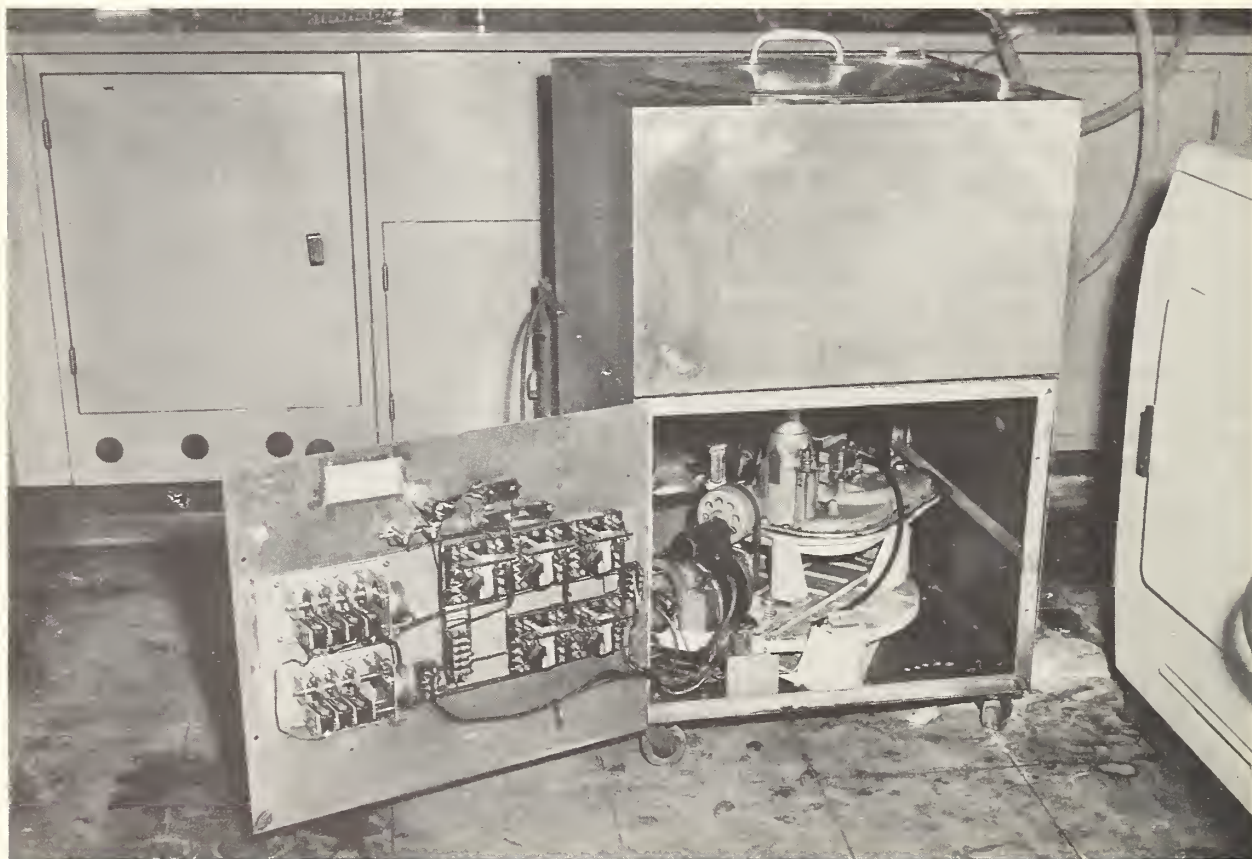
The Causticaire machine is designed to treat 60 ten-gram samples of lint cotton with sodium hydroxide solution, water-rinse the caustic soda from the cotton, and damp-dry the samples automatically in 49 minutes. The machine agitates bagged test specimens of lint cotton in a solution of sodium hydroxide in the tub of the machine; withdraws the used caustic soda solution into a storage tank for reuse; and provides three agitated rinsings of the specimens in fresh warm water, each rinsing followed by a centrifugal extraction and discharge of the water as waste. An adjustable timer automatically controls the sequence and duration of these functions. The machine incorporates the principal mechanical assemblies of domestic washing machines. Essentially, the apparatus comprises a processing chamber or tub, a rotatable sample basket and an agitator mounted within the tub, mechanism for spinning the basket and oscillating the agitator, a storage tank for sodium hydroxide solution, a mixing valve for controlling rinse water temperature, a pump for handling the caustic soda solution and rinse water, and a sequence timer system and solenoid valves for process control, all housed in a cabinet as shown in figure 3. It is a caster-mounted machine powered by two fractional horsepower electric motors. The approximate overall dimensions are 24 inches wide, 40 inches long, and 40 inches high.

The description which follows applies to design features and arrangement of parts for the prototype Causticaire machine (fig. 3). The design and arrangement of individual elements of the machine can be varied. For instance, the storage tank can be a separate receptacle attached to the machine, and other features, such as drive transmission, pumping arrangements, and timing



Figure 3.--Prototype Causticaire machine.
View 1, front of machine; View 2, control
panel and operating mechanism.

View 1' N-29743



View 2

N-29744

control system, may differ depending on the make of washing machine selected for conversion.

Framework

The framework of the machine consists of lightweight angle-iron members arranged to support the drive transmission for operating the sample basket and the agitator, the fluid-handling pump, and the drive motors. These elements are attached to the base of the angle-iron frame. The frame is enclosed by removable sheet-metal panels on three sides, and a hinged panel on the front. On this hinged panel are mounted the controls for operating the machine, including a start-and-stop switch, telltale light, fuses, and a sequence timer with associated circuit switches and relays.

Storage Tank and Tub Assembly

Mounted on top of the framework is a covered rectangular dual-purpose receptacle serving as the solution storage tank and processing tub. Formed within this rectangular receptacle is a circular compartment whose sidewall is integrant with the bottom and the cover of the receptacle. The outer section of the rectangular receptacle provides a 12-gallon storage tank for sodium hydroxide solution, and the inner circular compartment serves as a tub for processing test specimens.

The storage tank is provided with a removable closure in its top for convenience in filling, checking the level of the solution, and taking specific gravity readings of the sodium hydroxide solution. Pipe connections for pumping the solution and draining the storage tank are provided.

The inner circular tub is provided with a removable cover to permit access to the sample basket, and to prevent possible splashing out of the solution during operation of the machine.

The overall dimensions of the receptacle are 24 inches wide, 24 inches deep, and 15 inches high. The inner tub is 18-1/8 inches in diameter and 15 inches high. The receptacle is constructed of stainless steel sheet metal.

Sample Basket and Agitator

Chemical treatment and rinsing of test specimens, or samples, take place in a perforated circular sample basket.

The sample basket and a vaned agitator are mounted concentrically within the circular tub. These rotary members of the machine are connected with the respective shafts of the drive transmission for spinning the basket and oscillating the agitator. The sample basket is constructed to run true at maximum spin-speed with varying loads of samples. The agitator unit is designed to oscillate without creating violent turbulence of the fluid or causing excessive tumbling of the samples during agitation.

The sample basket, agitator, and the drive shaft housing extending within the tub area are constructed of stainless steel or other material suited for use with caustic soda solutions. The drive shaft housing is sealed to prevent entry of fluids.

The overall dimensions of the sample basket are 16-1/8 inches in diameter and 10-1/4 inches high.

Drive Transmission Unit

Generally, the mechanism found on domestic washing machines for operating the agitator and spinning the basket for damp-drying will be satisfactory for use as a drive transmission unit of the Causticaire machine. The mechanism should oscillate the agitator at a rate to cause thorough soaking of the samples with fluid, and also spin the sample basket for thorough extraction of fluids from the samples without causing the cotton fibers to become excessively matted and lumpy. Matted fibers later will cause difficulty in reblending the cotton samples for Micronaire reading.

The transmission unit is driven by a fractional horsepower motor controlled by relays connected with the automatic timer of the machine.

Pump Unit

A stainless steel reversible pump is incorporated with the mechanism of the Causticaire machine to handle the caustic soda solution and the water used in processing the cotton samples. This pump is a positive displacement type, operated to deliver 10 gallons of fluid per minute. The impeller and shaft packing of the pump are especially adapted for service with sodium hydroxide solution. The pump is driven by a reversible motor controlled by relays connected with the automatic timer of the machine.

The pump unit includes a three-way solenoid-activated stainless steel valve, a trap strainer, and noncorrodible piping to carry the sodium hydroxide solution from the storage tank to the tub and return the solution to the storage tank for reuse. As shown in the schematic diagram (fig. 4) the pump unit also includes a two-way solenoid-activated bronze valve, a thermostatically controlled water-mixing valve, and associated piping to fill the tub with blended hot-and-cold water to the correct level, and then discharge this water as waste.

Under control of the machine's timing unit the pump will fill the tub at a rate of approximately 10 gallons per minute with either sodium hydroxide solution or water prior to each operation of the agitator, and then empty the tub at the same rate upon completion of the operation. The pump operates continuously to discharge fluids during the periods of centrifuging and extraction of liquids from the samples.

A trap strainer is located in the outlet line of the tub in a position accessible for cleaning. The retaining nut of the strainer is provided with a

petcock for draining the strainer when the filter element is removed for cleaning.

The thermostatically controlled water-mixing valve of the pump unit is adjustable within a temperature range of 65° to 115° F. Provisions are made on this mixing-valve for connection to hot and cold water supply lines.

Piping Layout

Selection of material for the respective pipelines and valves of the machine is governed by service conditions. Stainless steel, or other material highly resistant to corrosion, should be used where caustic soda solution is conveyed without subsequent flushing of the lines with water. Care should be exercised in making pipe, or tubing, connections to assure leak-proof service under normal conditions of machine vibration and use of a wetting agent in the sodium hydroxide solution.

Threaded pipe joints should be made up tight without the use of a thread-sealing compound. Solvent action of the caustic soda solution together with the penetrating characteristic of the wetting agent frequently cause failure of a sealing compound, with resultant leaky threaded connections.

The piping layout of the prototype machine (fig.4) includes a thermostatically controlled hot and cold water mixing valve, check valves to control the direction of flow through the trap strainer, a manual cutoff valve at the outlet of the caustic soda solution storage tank, and a manual draincock for draining the storage tank and the tub. This system is based on delivery of 10 gallons per minute of sodium hydroxide solution and 10 gallons per minute of tempered water.

An alternate piping layout is illustrated schematically in figure 5. Essentially this arrangement provides separate systems for handling the sodium hydroxide solution and the rinse water. The system is based on delivery of 10 gallons per minute of sodium hydroxide solution and 5 gallons per minute of tempered water. The direction of flow of the sodium hydroxide solution is controlled by a reversible motor-driven stainless steel positive displacement pump and a three-way stainless steel solenoid valve, which are under the direction of the automatic timer.

Hot and cold water are fed to a thermostatically controlled mixing valve at line pressure to furnish tempered rinse water. The volume of tempered rinse water supplied to the machine is controlled by a regulating valve to maintain a flow rate of 5 gallons per minute. A solenoid valve actuated by the automatic timer of the machine controls the flow of rinse water to the tub. A motor-driven water pump, operated by the automatic timer, handles all waste water.

Associated shutoff valves, drain valves, check valve, and a strainer complete this system of piping.

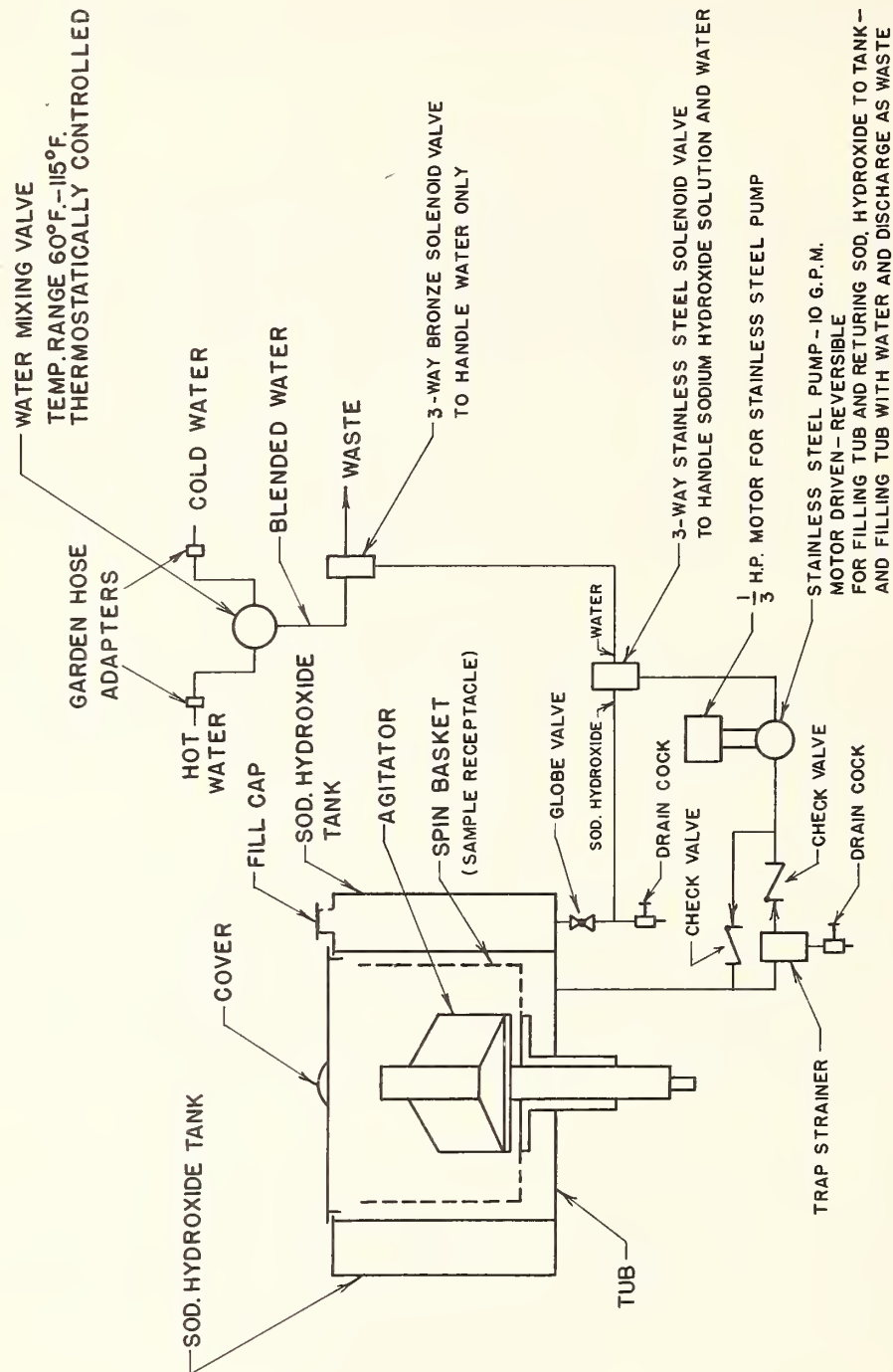


Figure 4.--Piping and fluid control system of the prototype Causticaire machine.

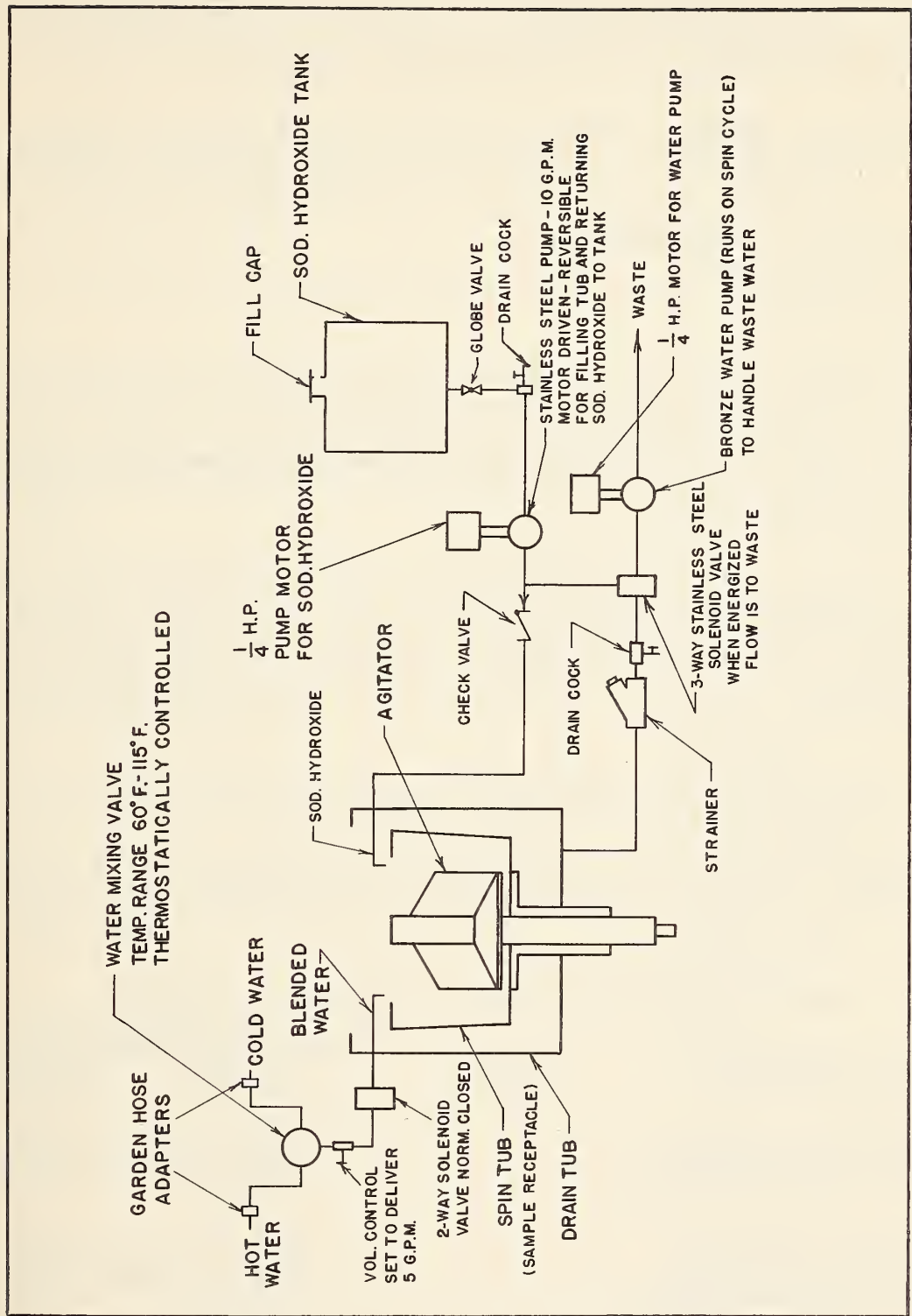


Figure 5.--- Alternate piping and fluid control system for Causticaire machine.

Timing Unit

The cycle, or series of operations, of the Causticaire machine is controlled by a multiple-circuit timer, to regulate the sequence and duration of each phase of operation of the machine as described in the following section, on "Function and Timing Cycle for the Causticaire Machine."

The timer is similar in design to the types of timers generally used with domestic washing machines. It includes the following features of operation:

1. Initiates and completes a single cycle of 49-minute duration when the primary circuit is closed manually.
2. The operation of the machine can be stopped at any desired instant by opening the timing circuit.
3. The timer should be arranged for selective operation of any single function or phase of the process and for selective change of sequence and/or duration of the functions and phases by manipulation of an indexed control dial. (The timing unit of the prototype Causticaire machine shown in figure 3 was not adjustable for selective phase operation, and it was not equipped with a marked and indexed dial.)
4. The timer should be equipped with a marked and indexed control dial, or knob, to indicate the function or phase of the cycle being controlled by the timer when operating. The dial will be marked in the order of sequence of the functions; will indicate the period, or duration, of each function by divisions on the dial; and will be marked to indicate the "on" and "off" positions of the timer.
5. The indexed dial should be mounted in an accessible position on the outside of the machine for convenience of manipulation.

Based on delivery of 10 gallons per minute of sodium hydroxide solution and 10 gallons per minute of tempered water to the automatic Causticaire machine, a batch of samples can be processed in 49 minutes.

Function and Timing Cycle for the Causticaire Machine

<u>Order and function</u>	<u>Minutes</u>	<u>Machine operation</u>	
		<u>Component</u>	<u>Condition</u>
1. Fill tub with sodium hydroxide solution from storage tank (start cycle)	1	Pump Sample basket Agitator	- run - idle - idle
2. Treatment of samples with sodium hydroxide solution under agitation	4	Pump Sample basket Agitator	- idle - idle - run

Order and function	Minutes	Machine operation	
		Component	Condition
3. Drain tub of sodium hydroxide solution into storage tank	1	Pump Sample basket Agitator	- reverse - idle - idle
4. Extraction of sodium hydroxide solution from samples into storage tank	5	Pump Sample basket Agitator	- reverse - spin - spin
5. Safety idle period	1	Pump Sample basket Agitator	- idle - idle - idle
6. Fill tub with tempered rinse water	1	Pump Sample basket Agitator	- run - idle - idle
7. Rinsing samples with water under agitation (first rinse)	4	Pump Sample basket Agitator	- idle - idle - run
8. Drain tub of rinse water to waste	1	Pump Sample basket Agitator	- reverse - idle - idle
9. Extraction of rinse water from samples to waste	5	Pump Sample basket Agitator	- reverse - spin - spin
10. Safety idle period	1	Pump Sample basket Agitator	- idle - idle - idle
11. Fill tub with tempered rinse water	1	Pump Sample basket Agitator	- run - idle - idle
12. Rinsing samples with water under agitation (second rinse)	4	Pump Sample basket Agitator	- idle - idle - run
13. Drain tub of rinse water to waste	1	Pump Sample basket Agitator	- reverse - idle - idle
14. Extraction of rinse water from samples to waste	5	Pump Sample basket Agitator	- reverse - spin - spin

<u>Order and function</u>	<u>Minutes</u>	<u>Machine operation</u>	
		<u>Component</u>	<u>Condition</u>
15. Safety idle period	1	Pump	- idle
		Sample basket	- idle
		Agitator	- idle
16. Fill tub with tempered rinse water	1	Pump	- run
		Sample basket	- idle
		Agitator	- idle
17. Rinsing samples with water under agitation (third and final rinse)	4	Pump	- idle
		Sample basket	- idle
		Agitator	- run
18. Drain tub of rinse water to waste	1	Pump	- reverse
		Sample basket	- idle
		Agitator	- idle
19. Extraction of rinse water from samples to waste (end of cycle)	6	Pump	- reverse
		Sample basket	- spin
		Agitator	- spin
20. Elapsed time to momentary starting contact for new cycle	1	Pump	- Off
		Sample basket	- Off
		Agitator	- Off

After the damp-dried test samples are removed from the Causticaire machine, it is necessary to reduce further their moisture content for subsequent reconditioning of the cotton at standard laboratory testing conditions of temperature and humidity. The bagged test samples can be dried in a laboratory oven for drying and conditioning textiles. However, a conventional laboratory drying oven usually is too small and slow to dry the number of test samples which can be processed per hour with the Causticaire machine.

THE DRYER

The sample dryer recommended for use with the Causticaire machine is an electric blower-type domestic clothes dryer equipped with sheathed heating elements and perforated tumbler drum. These automatic dryers have ample capacity for drying the Causticaire samples. The tumbling action given the bagged samples by the revolving drum tends to loosen lumped fibers and to effect more uniform drying throughout the mass of cotton.

Modification of a Clothes Dryer for Causticaire Sample Drying

For application as a dryer for Causticaire samples, the automatic domestic clothes dryer will require modification of the temperature control system to provide sufficient heat to dry the samples rapidly. Most automatic clothes dryers have thermostats that control drying temperatures below the maximum

temperature required for efficient drying of Causticaire samples. The thermostats also operate at an undesirably wide temperature differential. These dryers are also provided with an over-temperature electrical safety cutout which turns off the heating unit if the temperature of the air in the dryer should exceed the maximum drying temperature.

Modification of the temperature-control system of domestic electric clothes dryers for Causticaire sample drying requires (1) removal of the over-temperature cutout from the temperature-control circuit, or substitution of a cutout set to operate at a higher temperature, and (2) replacement of the dryer thermostat with a thermostat adjustable to a higher maximum temperature (fig.6).

The replacement thermostat selected for dryer temperature control should be responsive to a range of 70° to 250° F., and should operate at any selected temperature without wide overshooting and undershooting.

A suitable surface-mounting thermostat for replacement of the temperature-control device on the dryer may be obtained from the manufacturers of the sheathed heater units customarily used in domestic clothes dryers. Such a thermostat has a temperature-sensitive bulb with 7 feet of capillary actuating tubing, an adjustable calibrated dial covering a temperature range of 60° to 250° F., a differential of 10° F. between opening and closing of contacts, and double-pole single-throw switch contacts with current carrying capacity of 6 kw.

The efficiency of various types of commercial clothes dryers as a means of reducing the moisture content of bagged test samples will vary somewhat. Generally, 60 damp-dried Causticaire samples can be sufficiently dried and cooled for laboratory reconditioning of the cotton in 1-1/2 hours of dryer operation with the thermostat set to control at a temperature of 220° F.

OPERATION OF THE CAUSTICAIRE MACHINE AND THE DRYER

Installation and operation of the Causticaire machine is similar to that of an automatic domestic washing machine.

The machine can be connected to cold and hot water supply lines by hose attached to standard threaded garden hose adapters on the inlet ports of the machine. An additional length of hose will be required to conduct the waste water from the outlet port of the machine to a drain.

The thermostatically controlled water-mixing valve on the Causticaire machine is generally set for feed-water temperature of 105° to 110° F.

The quantity and concentration of sodium hydroxide solution in the storage tank of the Causticaire machine should be checked before processing a batch of samples.

After the Causticaire machine is connected with a suitable electric circuit, water supply turned on, supply of caustic soda solution checked, samples put into the sample basket of the machine, and the starting switch closed, the machine will automatically perform its functions without further attention.



BN-7898

View 1

Figure 6.--Modified laundry dryer for drying Causticaire test samples. View 1, top of machine showing adjustable thermostat (left, rear) and timer (right, rear). View 2, tumbler drum with bagged samples.



BN-7899

View 2

As a precautionary measure, the condition of the machine's filter element should be checked frequently. A clogged filter element can cause improper functioning of the machine. If a sample bag becomes untied during a processing phase, the escaped fibers may completely clog the filter element. If the pump starts laboring and the volume of fluid being delivered is less than normal, it is advisable to check the condition of the filter element and also the seats of the solenoid valves for excessive accumulation of cotton fibers.

Installation and operation requirements of the modified sample dryer are similar to those of an electric blower-type domestic clothes dryer. Drying time for the Causticaire samples, with the dryer temperature controlled at approximately 220° F., will vary somewhat for different make and style of domestic clothes dryers. The correct degree of sample drying can be accomplished by adjusting the temperature-indicating thermostat and resetting the dial-indicating timer of the dryer for a longer or shorter drying period.

